

CLAIMS

1. A device for bonding objects to be bonded each having a metal bonding portion on a surface of a substrate, comprising:

cleaning means for exposing the surfaces of the metal bonding portions to a plasma having an energy enough to etch the surfaces of the metal bonding portions at a depth of 1.6 nm or more over the entire surfaces of the metal bonding portions under a reduced pressure; and

bonding means for bonding the metal bonding portions of said objects taken out of said cleaning means to each other in an atmospheric air.

2. The bonding device according to claim 1, wherein said bonding means has heating means and bonds the metal bonding portions to each other at a temperature of 180°C or lower.

3. The bonding device according to claim 1, wherein the surfaces of the metal bonding portions to be bonded to each other are both formed from gold.

4. The bonding device according to claim 1, wherein said cleaning means comprises an argon plasma irradiating means.

5. The bonding device according to claim 1, wherein said bonding means is means for making a dispersion of a gap between the metal bonding portions at the time of bonding to be 4μm or less at maximum.

6. The bonding device according to claim 1, wherein said bonding means is means for making a surface roughness of at least one metal bonding portion after bonding to

be 10 nm or less.

7. The bonding device according to claim 1, wherein a surface roughness of at least one metal bonding portion before bonding is made to be 100 nm or less.

8. The bonding device according to claim 1, wherein said bonding means is means for bonding the metal bonding portions to each other at a bonding load of 300 MPa or less.

9. The bonding device according to claim 1, wherein a surface hardness of the metal bonding portions is set at 100 or less in Vickers hardness Hv.

10. The bonding device according to claim 1, wherein said bonding means is means capable of adjusting a parallelism in a bonding area between substrates at the time of bonding the metal bonding portions to each other at 4 μ m or less.

11. The bonding device according to claim 1, wherein at least one metal bonding portion is formed by a plurality of bumps.

12. The bonding device according to claim 11, wherein a dispersion of bump height is 4 μ m or less.

13. A method for bonding objects to be bonded each having a metal bonding portion on a surface of a substrate, comprising the steps of:

 exposing the surfaces of the metal bonding portions to a plasma to etch the surfaces of the metal bonding portions at a depth of 1.6 nm or more over the entire

surfaces of the metal bonding portions under a reduced pressure; and

bonding the metal bonding portions after said plasma treatment to each other in an atmospheric air.

14. The bonding method according to claim 13, wherein the metal bonding portions are bonded to each other at a temperature of 180°C or lower.

15. The bonding method according to claim 13, wherein the metal bonding portions, the surfaces of which are both formed from gold, are bonded to each other.

16. The bonding method according to claim 13, wherein an argon plasma treatment is carried out.

17. The bonding method according to claim 13, wherein a dispersion of a gap between the metal bonding portions at the time of bonding is made to be 4μm or less at maximum.

18. The bonding method according to claim 13, wherein a surface roughness of at least one metal bonding portion after bonding is made to be 10 nm or less.

19. The bonding method according to claim 13, wherein a surface roughness of at least one metal bonding portion before bonding is made to be 100 nm or less.

20. The bonding method according to claim 13, wherein the metal bonding portions are bonded to each other at a bonding load of 300 MPa or less.

21. The bonding method according to claim 13, wherein a surface hardness of the metal bonding portions is set at 100 or less in Vickers hardness Hv.
22. The bonding method according to claim 13, wherein a parallelism in a bonding area between substrates at the time of bonding the metal bonding portions to each other is adjusted at 4 μ m or less.
23. The bonding method according to claim 13, wherein at least one metal bonding portion is formed by a plurality of bumps.
24. The bonding method according to claim 23, wherein a dispersion of bump height is 4 μ m or less.
25. A bonded material of objects bonded to each other each having a metal bonding portion on a surface of a substrate, made by exposing the surfaces of the metal bonding portions to a plasma to etch the surfaces of the metal bonding portions at a depth of 1.6 nm or more over the entire surfaces of the metal bonding portions under a reduced pressure, and after said plasma treatment, bonding the metal bonding portions to each other in an atmospheric air.
26. The bonded material according to claim 25, wherein at least one object comprises a semiconductor.